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9608/23

October/November 2020

**2 hours**

You must answer on the question paper.

No additional materials are needed.

- Answer **all** questions.
- Use a black or dark blue pen.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use an HB pencil for any diagrams, graphs or rough working.
- Calculators must **not** be used in this paper.

- The total mark for this paper is 75.
- The number of marks for each question or part question is shown in brackets [ ].
- No marks will be awarded for using brand names of software packages or hardware.

This document has **16** pages. Blank pages are indicated.

- 1 (a) A programmer uses the process of stepwise refinement to break down a problem.

Explain the purpose of stepwise refinement.

.....

.....

.....

..... [2]

- (b) Programming languages support different data types. These usually include `STRING` and `REAL`.

Complete the table by giving **four other** data types **and** an example data value for each.

Data type	Example data value

[4]

- (c) An experienced programmer is working on a program that is written in a language she is not familiar with.

- (i) State **one** feature of the program that she should be able to recognise.

.....

..... [1]

- (ii) State the type of skill that would allow her to recognise this feature.

.....

..... [1]

- (d) Give **three** methods that may be used to identify and locate errors in a program **after it has been written**.

You may include **one** feature found in a typical Integrated Development Environment (IDE).

1 .....

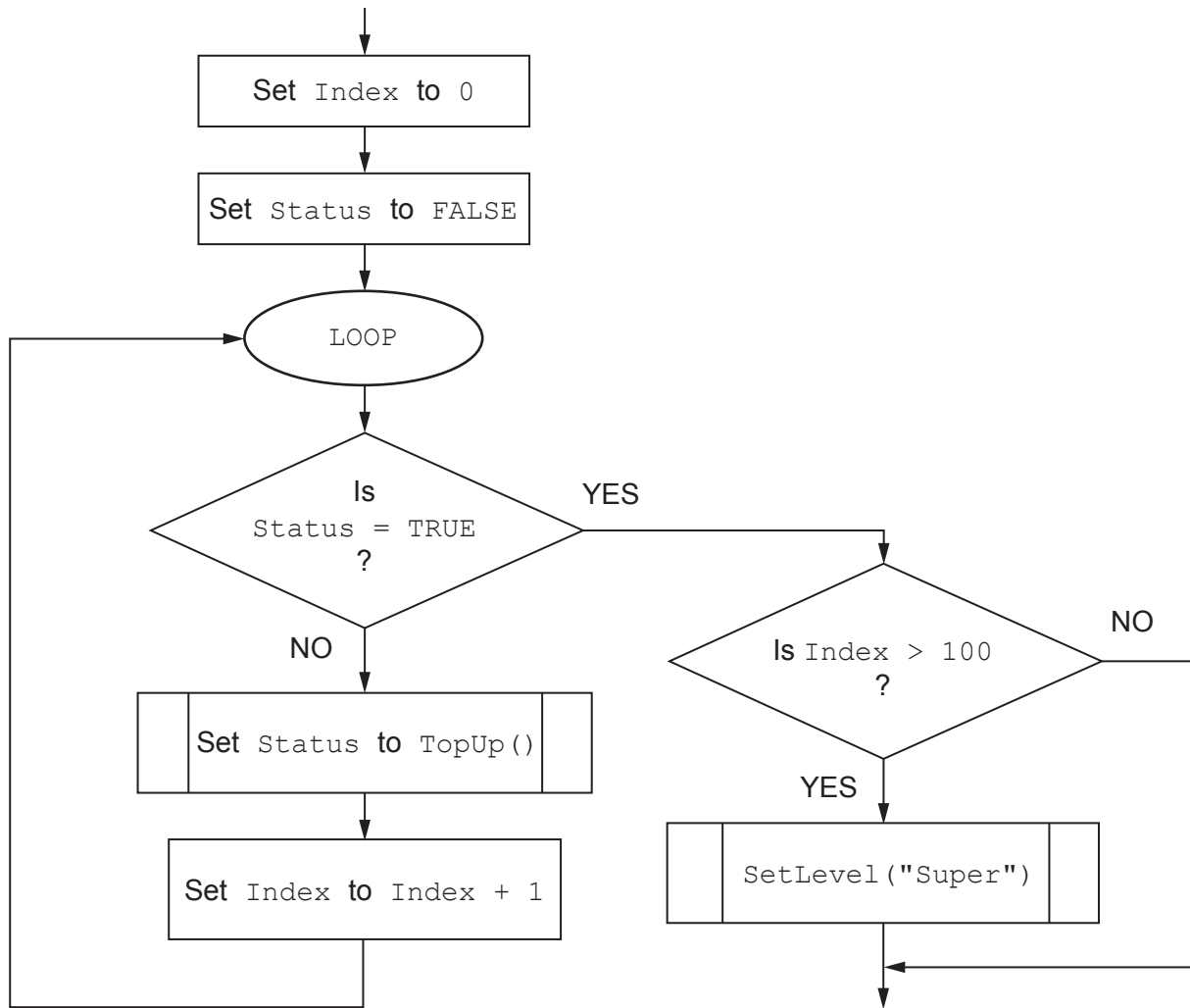
2 .....

3 ..... [3]

- [8]

- | Statement                                    | Error |
|--|-------|
| Code $\leftarrow$ LEFT(3, "Europe")          |       |
| Hour $\leftarrow$ MID("ALARM:12:02", 7, 6)   |       |
| Size $\leftarrow$ LENGTH(27.5)               |       |
| Num $\leftarrow$ INT(27 / (Count + 3))       |       |
| Result $\leftarrow$ "Conditional" AND "Loop" |       |

(c) Part of a program flowchart is shown.



Write **program code** to implement the flowchart shown. Variable declarations are not required.

Programming language .....

Program code

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

[6]

- 3 A global 1D array, `ProdNum`, of type `INTEGER` contains 5000 elements and is used to store product numbers.

A procedure is needed to sort `ProdNum` into ascending order using a bubble sort algorithm.

Write **program code** for the procedure `BubbleSort()`.

Visual Basic and Pascal: You should include the declaration statements for variables.

Python: You should show a comment statement for each variable used with its data type.

Programming language .....

## Program code

[illegible]

.....

.....

..... [7]

- 4 (a) The following pseudocode includes a procedure that searches for a value in a 1D array and outputs each position in the array where the value is found.

Refer to the **Appendix** on page 16 for the list of built-in functions and operators.

```

DECLARE NameList : ARRAY [1:100] OF STRING
DECLARE SearchString : STRING

PROCEDURE Search()
  DECLARE Index : INTEGER

  FOR Index ← 1 TO 100
    IF NameList[Index] = SearchString
      THEN
        OUTPUT "Found at " & NUM_TO_STRING(Index)
      ENDIF
    ENDFOR
  ENDPROCEDURE

```

The specification of module `Search()` changes. The pseudocode needs to be amended to meet a new requirement.

The procedure needs to be implemented as a function, `Search()`, which will:

- take the search value as a parameter
- return an integer which is:
  - either the index value where the search value is **first** found
  - or `-1` if the search value is **not** found.

[6]

Give the term used for this type of modification.

..... [1]

Give **another** reason for the modification of an algorithm.

..... [1]

(d) Consider the following pseudocode:

```

10 DECLARE VarA : INTEGER
11 VarA ← 20
12
13 CALL ProcA(VarA)
14 OUTPUT VarA          // first value output
15
16 CALL ProcB(VarA)
17 OUTPUT VarA          // second value output
18
19
20 PROCEDURE ProcA(BYVALUE ThisValue : INTEGER)
21     ThisValue ← ThisValue + 5
22 ENDPROCEDURE
23
24 PROCEDURE ProcB(BYREF ThisValue : INTEGER)
25     ThisValue ← ThisValue + 5
26 ENDPROCEDURE

```

Procedures `ProcA()` and `ProcB()` use two methods of passing parameters.

Complete the following table.

	Output	Explanation
First value (line 14)	.....	..... ..... .....
Second value (line 17)	.....	..... ..... .....

[4]



(e) The procedures `ProcA` and `ProcB` in **part (d)** are examples of program modules.

Give **two** advantages of using program modules in program design.

1 .....

.....

2 .....

.....

[2]

- 5 A hashtag is used on a social media network to make it easier to find messages with a specific theme or content. A hashtag is a string consisting of a hash character '#' followed by a number of alphanumeric characters.

A message may contain several hashtag strings. A hashtag may be terminated by a space character, the start of the next hashtag, or by the end of the message.

For example, the following message contains three hashtags:

"#Alarm34 is the result of #BatteryFailure in the #PowerModule"

The hashtags in this message are "#Alarm34", "#BatteryFailure" and "#PowerModule".

A program is being developed to monitor their use.

The program will include two global arrays each containing 10 000 elements:

- A 1D array, `TagString`, of type `STRING` storing each hashtag in a single element of the array. All unused array elements contain an empty string ("").
- A 1D array, `TagCount`, of type `INTEGER` storing a count of the number of times each hashtag is used. The count value in a given element relates to the hashtag value stored in the element in the `TagString` array with the corresponding index value.

A developer has started to define the modules. Module `GetStart()` has already been written.

Module	Description
<code>GetStart()</code>	<ul style="list-style-type: none"> <li>• Called with two parameters: <ul style="list-style-type: none"> <li>◦ a message of type <code>STRING</code></li> <li>◦ an integer giving the number of the required hashtag; for example, <code>GetStart(Message, 3)</code> would search for the third hashtag in the string <code>Message</code></li> </ul> </li> <li>• Returns an integer value representing the start position of the hashtag in the message, or value <code>-1</code> if that hashtag does not exist</li> </ul>
<code>AddHashtag()</code>	<ul style="list-style-type: none"> <li>• Called with a hashtag of type <code>STRING</code></li> <li>• Copies the hashtag to the next free element of the <code>TagString</code> array, and sets the corresponding element of the <code>TagCount</code> array to 1</li> <li>• Returns <code>FALSE</code> if there are no unused elements in the <code>TagString</code> array, otherwise returns <code>TRUE</code></li> </ul>
<code>CountHashtag()</code>	<ul style="list-style-type: none"> <li>• Called with a message of type <code>STRING</code></li> <li>• Searches the message for hashtags using <code>GetStart()</code></li> <li>• Returns a value representing the number of hashtags in the message</li> </ul>
<code>IncrementHashtag()</code>	<ul style="list-style-type: none"> <li>• Called with a hashtag of type <code>STRING</code></li> <li>• Increments the value of the appropriate element in the <code>TagCount</code> array if the hashtag is found</li> <li>• Returns <code>TRUE</code> if the hashtag is found, or <code>FALSE</code> if the hashtag is not found</li> </ul>

(a) Write **pseudocode** for the module `AddHashtag()`.

[6]

The module description is repeated here for reference.

Visual Basic and Pascal: You should include the declaration statements for variables.  
Python: You should show a comment statement for each variable used with its data type.

Program code

[6]

The module description is repeated here for reference.

Visual Basic and Pascal: You should include the declaration statements for variables.  
Python: You should show a comment statement for each variable used with its data type.

Program code

[4]

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

[8]

## Appendix

### Built-in functions (pseudocode)

Each function returns an error if the function call is not properly formed.

**LENGTH**(ThisString : STRING) RETURNS INTEGER  
returns the integer value representing the length of string ThisString

Example: LENGTH("Happy Days") returns 10

**LEFT**(ThisString : STRING, x : INTEGER) RETURNS STRING  
returns leftmost x characters from ThisString

Example: LEFT("ABCDEFGH", 3) returns string "ABC"

**RIGHT**(ThisString: STRING, x : INTEGER) RETURNS STRING  
returns rightmost x characters from ThisString

Example: RIGHT("ABCDEFGH", 3) returns string "FGH"

**MID**(ThisString : STRING, x : INTEGER, y : INTEGER) RETURNS STRING  
returns a string of length y starting at position x from ThisString

Example: MID("ABCDEFGH", 2, 3) returns string "BCD"

**INT**(x : REAL) RETURNS INTEGER  
returns the integer part of x

Example: INT(27.5415) returns 27

**NUM\_TO\_STRING**(x : REAL) RETURNS STRING  
returns a string representation of a numeric value.  
Note: This function will also work if x is of type INTEGER

Example: NUM\_TO\_STRING(87.5) returns "87.5"

### Operators (pseudocode)

Operator	Description
&	Concatenates (joins) two strings Example: "Summer" & " " & "Pudding" produces "Summer Pudding"
AND	Performs a logical AND on two Boolean values Example: TRUE AND FALSE produces FALSE
OR	Performs a logical OR on two Boolean values Example: TRUE OR FALSE produces TRUE

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